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GB 2182130 A EP 0395344 A2 US 5134549 A
US 5057974 A US 4267489 A

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(54) Abstract Title
Lighting apparatus and illuminated signs

(57) A partially reflective panel comprises a sheet 22 with a pattern of light reflective areas 24 the remaining area able to transmit light. A layer of absorbent material may be provided behind the reflective pattern when viewed from the light source and may be on the same or opposite side of the sheet. The pattern may be formed by circular dots of various sizes to match the brightness of the light source therefore providing a uniform light. The sheet may be planar on both sides, one side may have a prismatic surface (28, figure 6b) to aid diffusion. The pattern may be formed by screen printing, etching or laminating a printed film. The panel may be incorporated into an internally lit container such as a sign or advertising hoarding (figure 4). The panels 22 may be mounted between the light source (12, figure 4) and the poster (10, figure 4). The back wall may be highly reflective and diffusive, reflecting 90% or more of the light. The back wall may be replaced by a second poster display panel (figure 9).

Figure 5

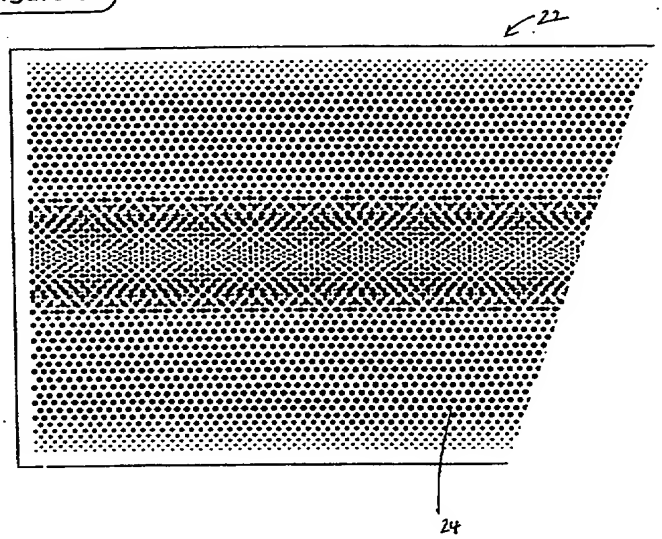

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Figure 1

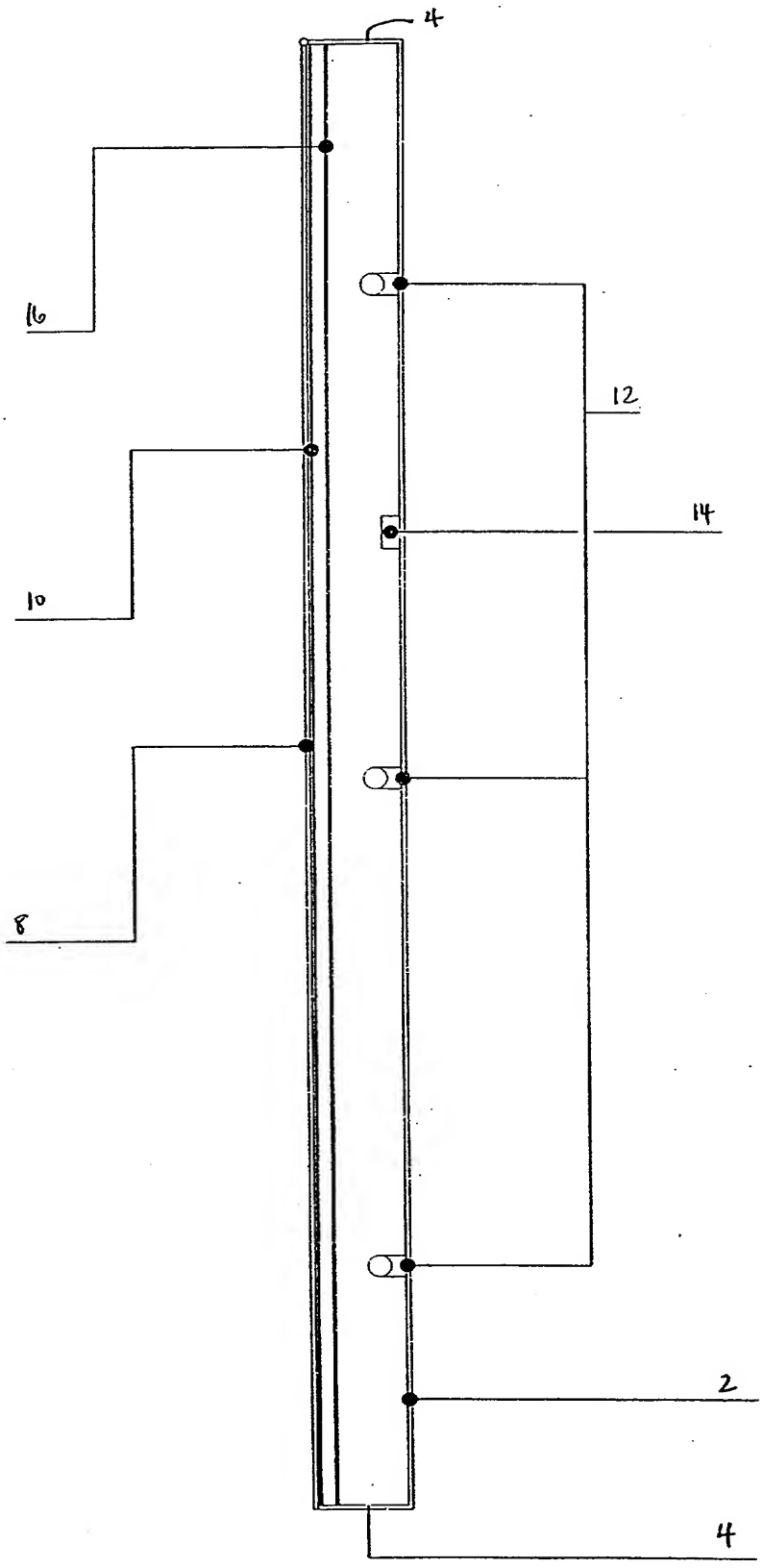


Figure 2

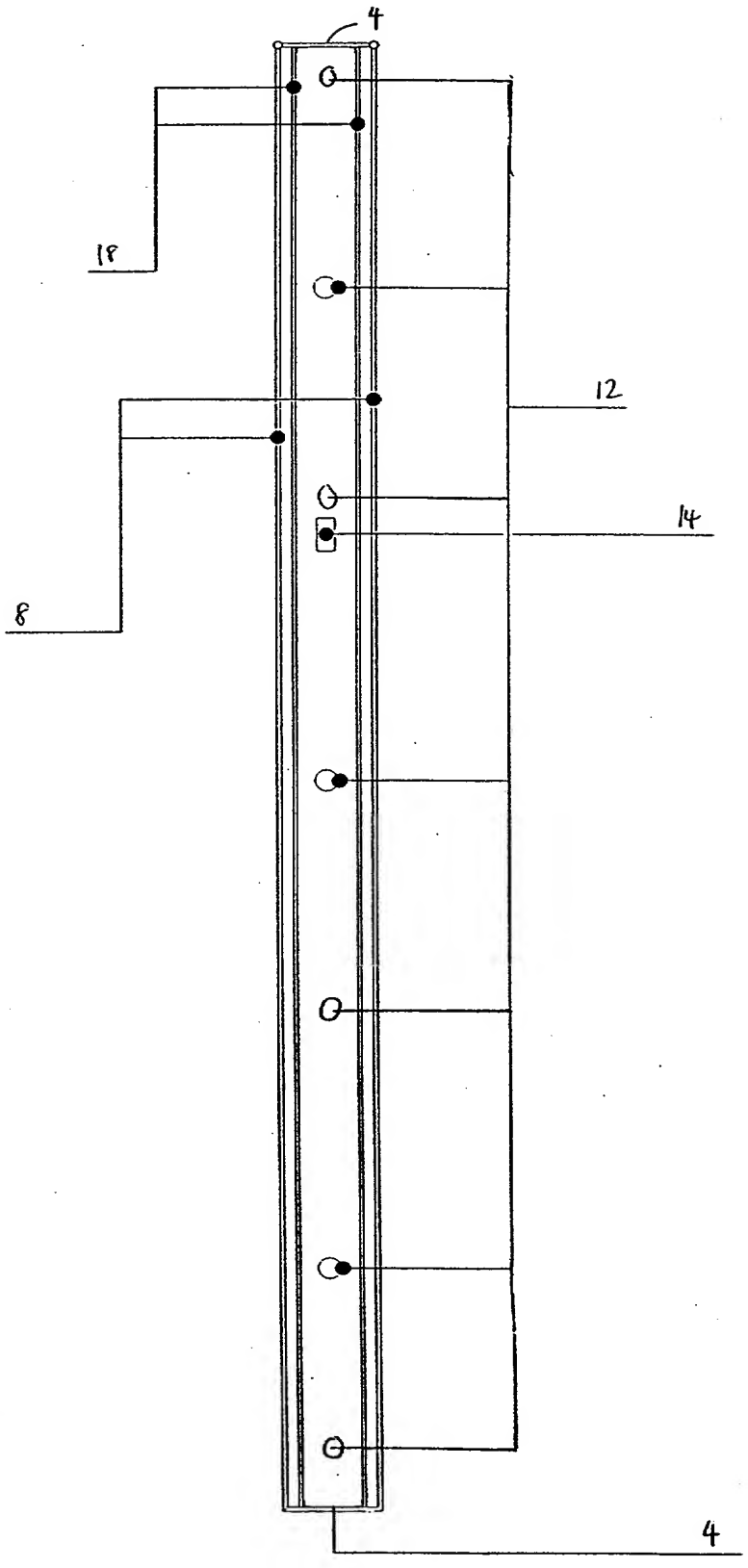


Figure 3

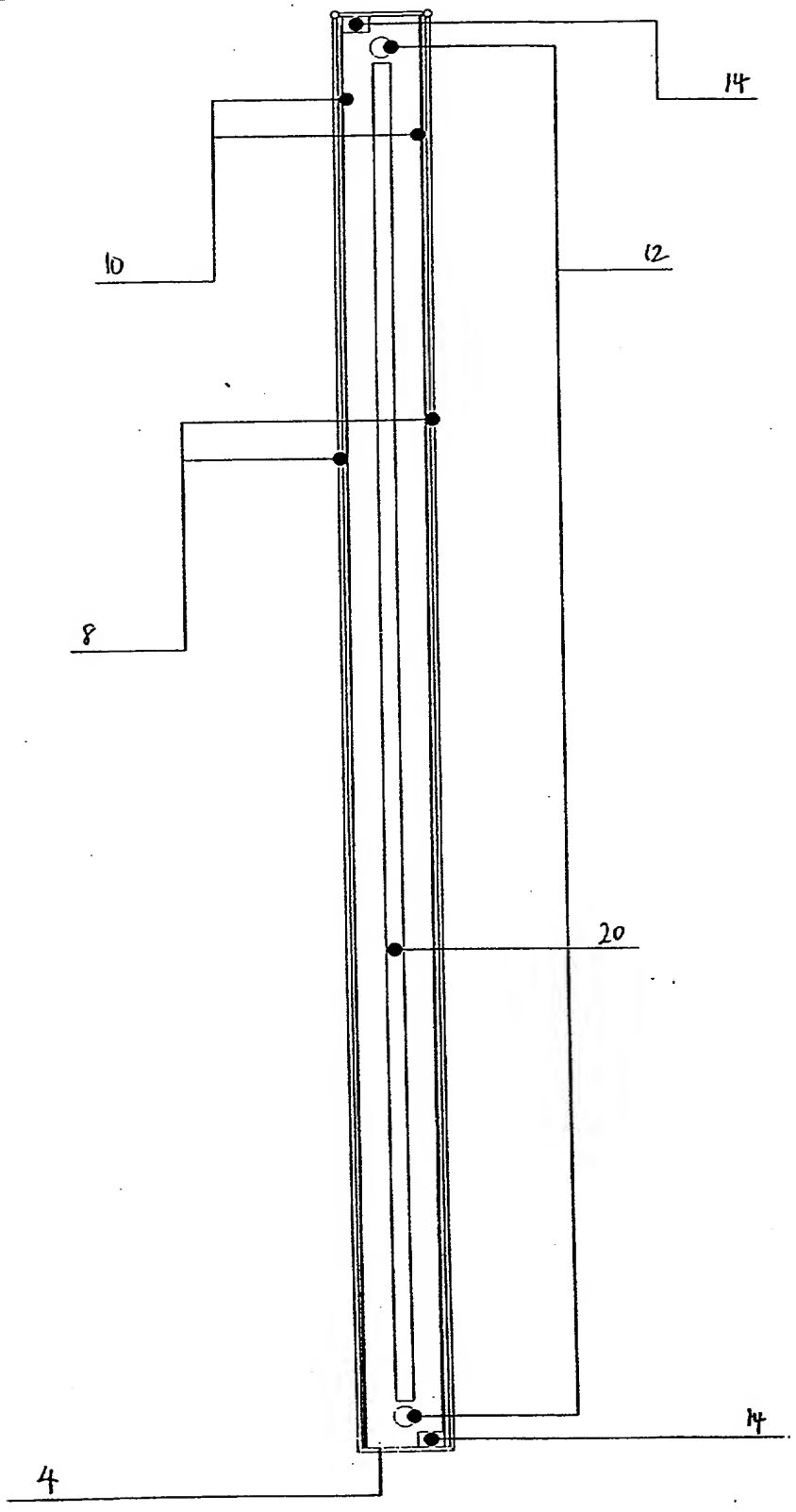


Figure 4

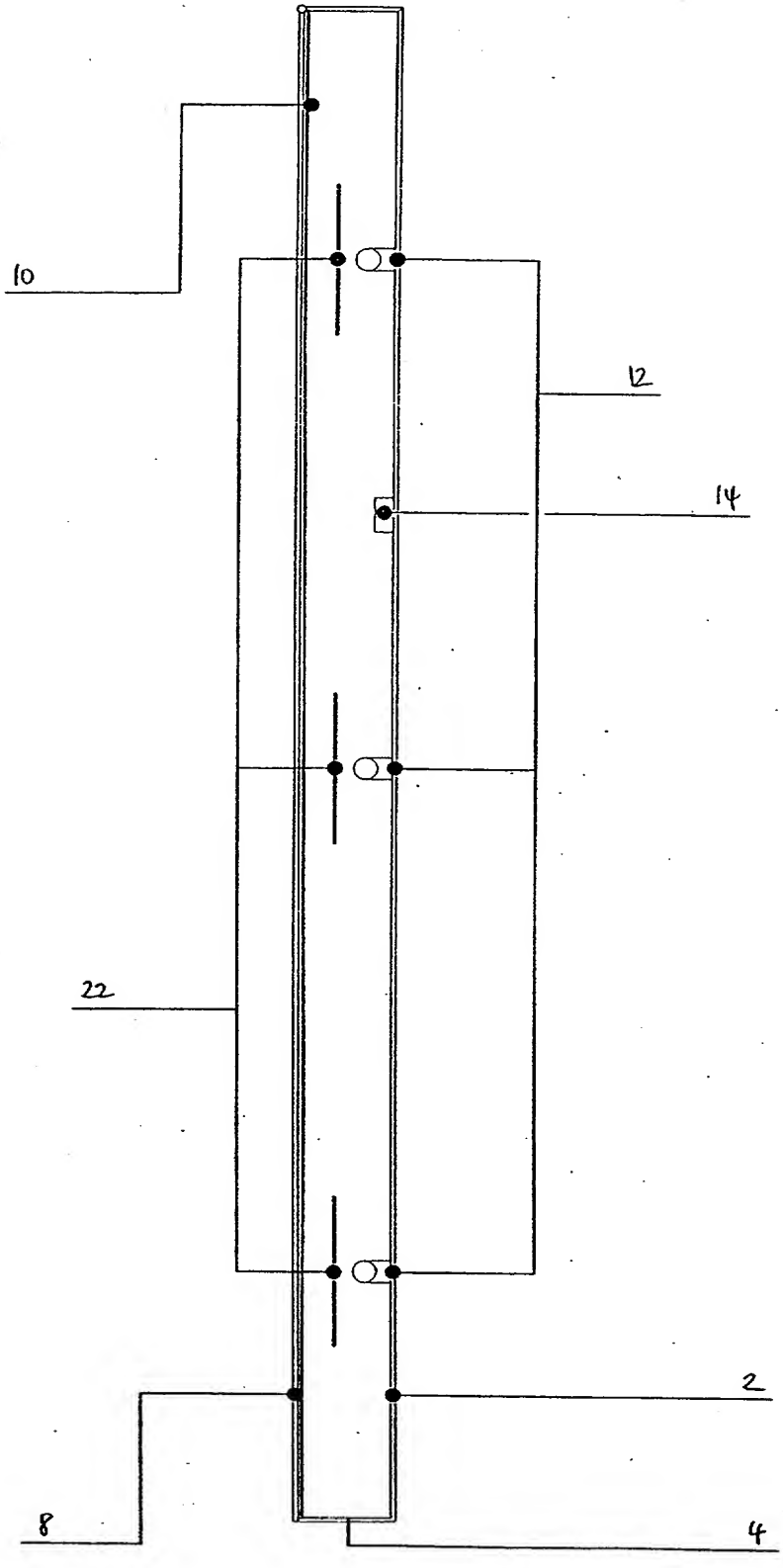
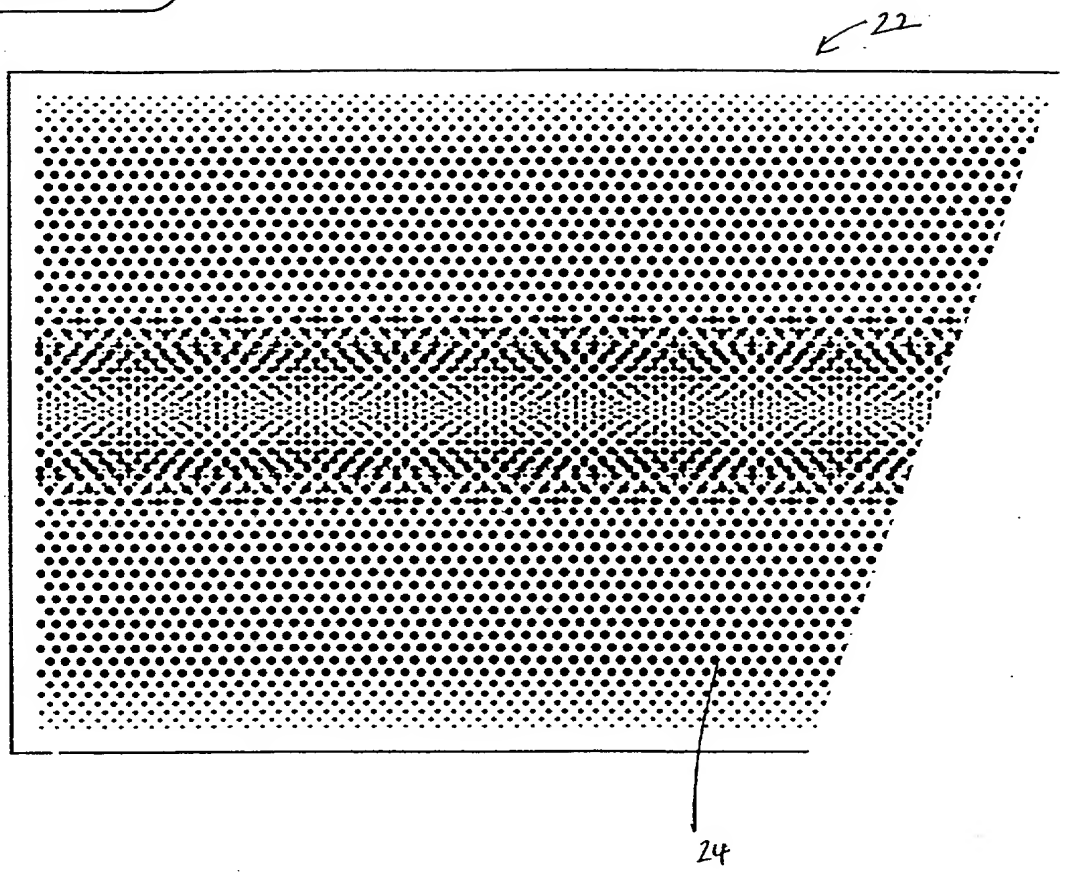


Figure 5



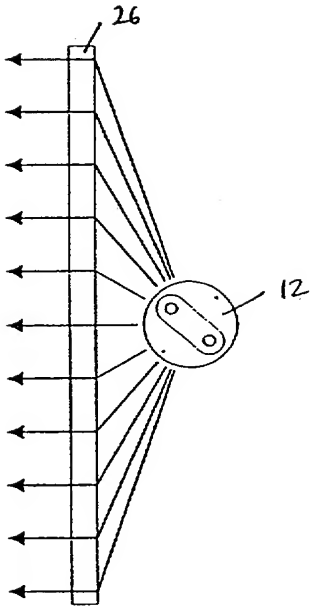


Fig 6A

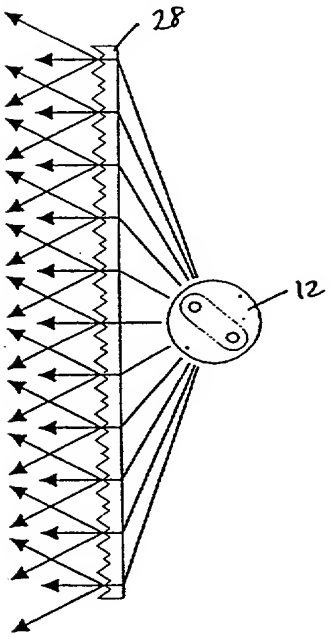


Fig 6B

Figure 7

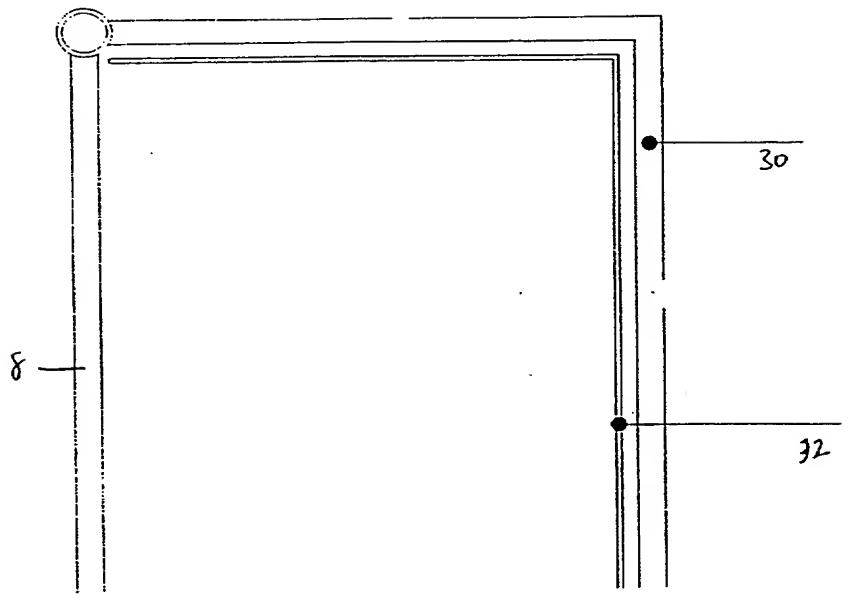


Figure 8

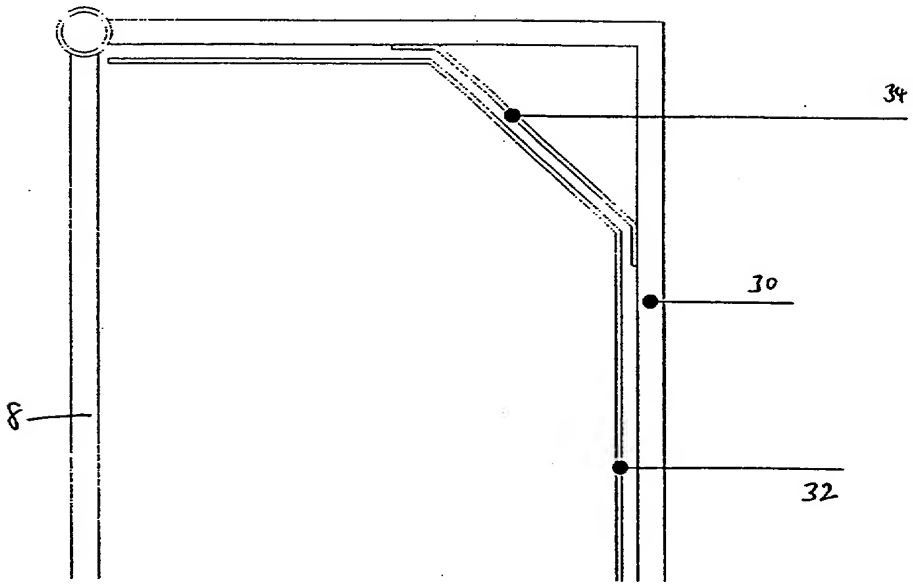
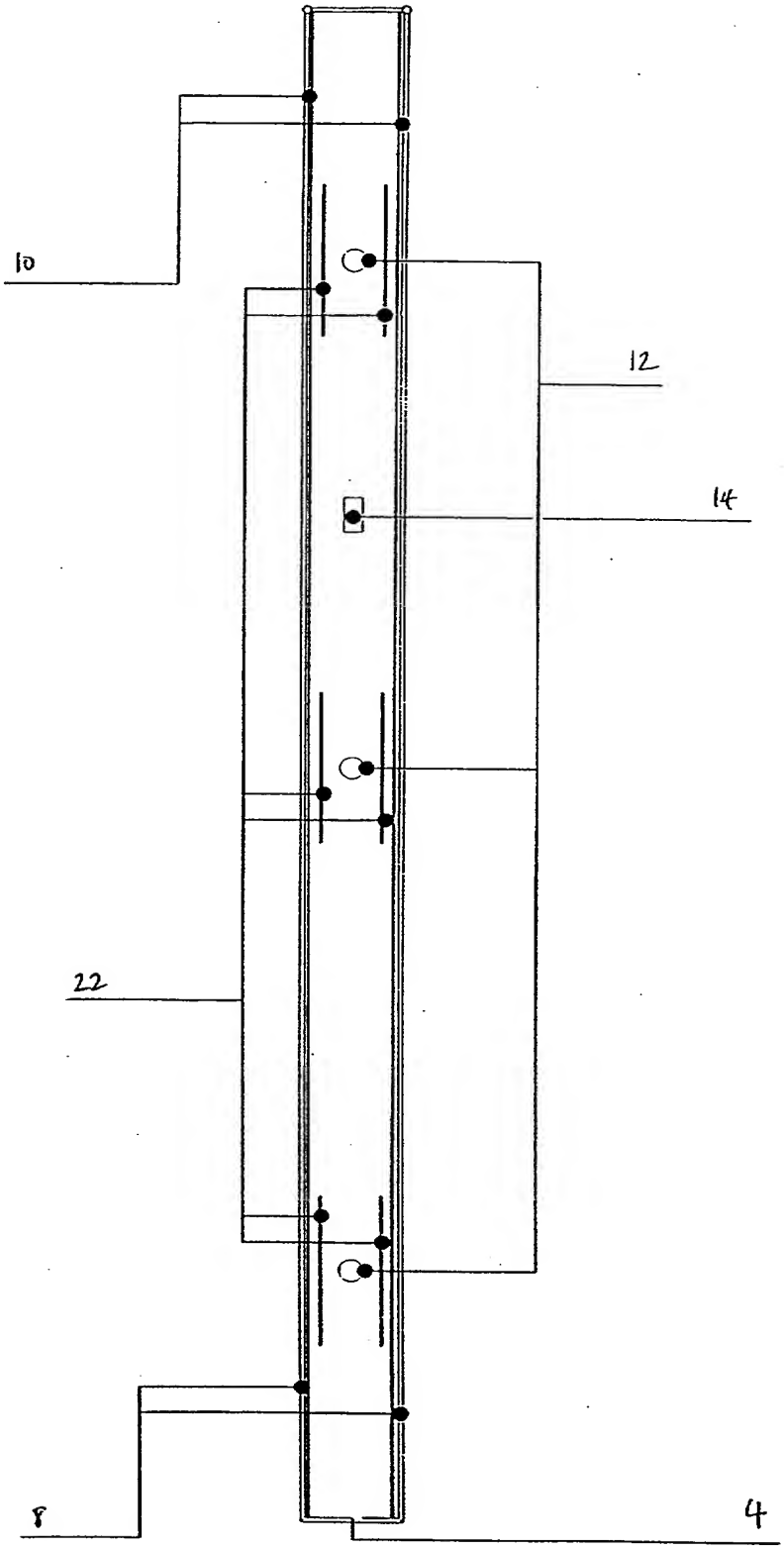


Figure 9



LIGHTING APPARATUS AND ILLUMINATED SIGNS

The present invention relates to lighting apparatus and illuminated signs. More particularly it seeks to provide a light source having a substantially uniform intensity of light output and also to provide even illumination of signs.

The use of signage is ubiquitous in society. It is widely utilised to inform viewers on matters such as safety, directions, public information and advertising. Signs may be illuminated or non-illuminated. Advertisers favour illuminated signs as they attract attention by day and are still effective at night. The great majority of advertising signs inside buildings are illuminated. This illumination may be from an external light source directed on to the front of the sign, or from light sources located behind a translucent sign formed of glass, plastic or reinforced paper, for example.

Back illuminated signs are often preferred as they are more reliable. The light sources, the control equipment and the sign itself are enclosed within a box and thus protected from the elements and vandalism. However, they have the drawback that much more light energy is needed to achieve the same level of light output as an equivalent front illuminated sign because light is absorbed by the translucent sign itself.

Because of the need to limit the weight of signs for handling purposes, to make maximum use of space available on sites and to improve the aesthetic appeal of signs, light boxes for back illuminated signs have to be relatively slim. This means that the illuminated face of the light box is rarely more than 200mm and often as little as 75mm from what is normally an intense light source such as a fluorescent lamp. Unless a diffusing medium is placed between fluorescent lamps and the face of the light box, the lamps are visible

as bright stripes and significantly degrade the legibility of the advertising or information message graphics.

A common method of reducing this "striping" effect is to install a diffuser, usually an opal acrylic or fibre glass sheet, which covers the full area of the light box, between the lamps and the translucent sign. However, such a diffuser typically absorbs 60% or more of the generated light. Light is also absorbed by the metal interior of the light box and the exposed wiring and electrical components. With this system, around 75% of the light emitted by the fluorescent lamps may be lost in absorption.

A second known method to reduce "striping" is to use a larger number of fluorescent lamps, which are closely spaced together in a relatively deep box. This configuration does not include a diffuser panel, but uses a thicker advertising poster, usually formed of vinyl, that acts as a limited area diffuser of the light. The higher cost of the heavier vinyl advertising posters is a serious drawback, particularly in outdoor advertising in which advertising posters are normally changed every two weeks. A further disadvantage of this method is that more lamps and control gear are required and therefore the likelihood of component failure is increased. Maintenance and supervision costs are also higher.

A third known method is "side illumination". In this system, lamps are placed in side apertures of the light box and intense light is directed across the face of the advertising poster. To achieve the necessary uniformity of illumination across the face, light from the lamps is projected through an acrylic sheet that has varying luminescence across its face. This method has disadvantages in terms of high material costs and excessive weight in standard and large signs.

The present invention provides a partially reflective panel comprising sheet material, areas of which reflect light energy and form a pattern extending in the plane of the sheet, with portions of the sheet material in the remainder of

the plane being able to transmit light energy. Panels of this form can be inserted in a lighting unit adjacent each light source. Also, they may be used in an existing illuminated sign to replace the original diffuser or provided in a new sign to provide even illumination across the sign, whilst minimising the amount of light energy absorption within the sign.

Preferably, the proportion of the plane of the sheet consisting of transmissive portions in one region of the sheet is different to that in another region. The transmissivity of the panel may thus be selected for particular regions to suit specific circumstances. More particularly, the proportion of the plane of the sheet consisting of transmissive portions in each region of the sheet may be selected to correspond to a specific light source such that the intensity of light transmitted by the panel when located adjacent the light source is substantially uniform over the plane of the panel.

Both sides of the panel may be substantially planar. Alternatively, prisms are provided on one side of the sheet to increase diffusion of light transmitted by the sheet. This may enable the number of lamps required for substantially even illumination of a given sign to be reduced.

In a preferred embodiment, each reflective area comprises a layer of light reflective material on one side of the sheet material, and the sheet material is substantially transparent to light energy to provide the transmissive portions. Preferably the layer of light reflective material is applied by a screen-printing process. Alternatively, the pattern of light reflective areas may be formed by etching a layer of light reflective material, or by laminating the sheet material with a printed film.

Advantageously, an absorbent material is provided below or behind the reflective portions. This absorbent material may be provided immediately below the reflective portions, for example with the reflective portions being printed onto the absorbent material, or the absorbent material may be

provided on the opposite side of the panel to the reflective portions. In either case, the absorbent material absorbs stray reflected light, and thereby helps ensure uniform light. The absorbent material is preferably only provided in correspondence to the reflective material so as not to absorb light passing the reflective material.

The invention further provides a method of producing light energy of uniform intensity comprising providing a light source, and locating adjacent to the light source a panel of the type defined herein.

The invention additionally provides an internally illuminable container comprising a front wall and side walls, at least one light source, and a panel as described above mounted between the light source and the front wall such that the intensity of light energy from the light source transmitted by the panel towards the inner surface of the front wall is substantially uniform.

In a preferred configuration, the container includes a back wall opposite the front wall, the surface of the back wall being highly reflective and diffusive. Preferably around 90% or more of the light energy incident thereon is reflected and diffused. The back wall may comprise a sheet of reflective and diffusive material on the inner surface thereof. In a further preferred embodiment, a panel of the invention is mounted between the at least one light source and each of the front and back walls.

Where the panel includes absorbent material, light transmitted through the panel and reflected from the front wall will be absorbed, and will therefore be prevented from being transmitted through the front wall. If the light is re-reflected through the front wall, this may result in non-uniform lighting.

Light boxes of the prior art and embodiments of the invention will now be described by way of example and with reference to the accompanying drawings, wherein:

Figures 1 to 3 are transverse cross-sectional views of known light boxes;

Figure 4 is a transverse cross-sectional view of a light box according to a first embodiment of the invention;

Figure 5 is a front view of a reflective panel in accordance with the invention;

Figures 6A and 6B are transverse cross-sectional views of reflective panels in accordance with the invention;

Figures 7 and 8 are partial cross-sectional views of light boxes in accordance with the invention; and

Figure 9 is a transverse cross-sectional view of a light box according to a second embodiment of the invention.

Examples of known light boxes are shown in Figures 1 to 3. The box of Figure 1 comprises an opaque back panel 2 and side panels 4, the box being closed by a transparent door 8. The door is typically made of glass or a polycarbonate material. A translucent poster 10 can be inserted adjacent the door 8. The poster is illuminable by three fluorescent tube lamps 12. Power is fed to the lamps from an external supply via control gear 14.

To reduce the "striping" effect referred to above, a diffuser 16 is provided between the lamps 12 and the poster 10. The diffuser may consist of a sheet of acrylic, glass reinforced plastic or mesh material.

The known light box of Figure 2 is a double sided light box configuration, having doors 8 with posters 10 behind them on both sides. It seeks to reduce "striping" by employing a larger number of lamps 12 together with relatively thick posters 18.

A third prior light box arrangement is shown in Figure 3. As in the example of Figure 2, the box is double sided. Rather than being spaced across the box,

lamps 12 are located at opposite ends of the box. Light from the lamps is directed into the edges of a translucent acrylic sheet 20 which extends between the lamps. To provide substantially uniform illumination across the sheet, the sheet has varying luminescence over its faces.

A light box incorporating patterned reflector/diffuser panels 22 according to an embodiment of the invention is illustrated in Figure 4. The configuration of the light box is the same as that of Figure 1, except the panels 22 are used in place of the single large diffuser sheet of Figure 1. Three panels 22 are mounted adjacent respective lamps 12, with the planes of the panels substantially parallel with that of the poster 10.

The panels may be formed of polycarbonate or acrylic material. The side of each reflective diffuser panel facing the respective lamp is patterned with light absorbing dots of a circular or other shape which may be provided by screen printing a suitable ink onto the panel. On top of the light absorbing dots are provided light reflecting dots, which may be provided by screen printing a reflective ink onto the panel. The reflective dots allow a calculated amount of light to pass directly through the panel 22 and the balance to be reflected on to the back panel 2. The balance of transmitted and reflected light can be varied by changing the reflective pattern on the panels 22 to optimise their use in different sizes of light boxes. It can also be varied according to the reflectivity of the interior of the box.

The light transmitted through the diffuser panel will be incident upon the rear of the poster 10. Much of this light will pass through the poster 10, thereby illuminating the poster 10. Some of the light will, however, be reflected. This light will be absorbed by the absorbent material provided on the diffuser panel. This will prevent the light being re-reflected onto the poster 10, which would otherwise create non-uniform illumination.

In an alternative configuration, the absorbent material may be provided on the side of the reflective diffuser panel opposite the lamp and the reflective material. The operation is unchanged.

Whilst the inclusion of absorbent material reduces the efficiency of the panel, since more available light is absorbed, it has been found that the improvement in uniformity of illumination outweighs this disadvantage.

When used in combination with a fluorescent tube, for example, the length of the corresponding panel is preferably about the same as that of the tube. The panel width is selected to be the minimum possible which achieves a sufficiently even intensity of incident light across the adjacent interior surface of the light box. The width may therefore be dependent on the number of lamps used, the spacing therebetween, and the diffusive and reflective properties of the back panel of the light box. For example, a 1500 by 180 mm reflective diffuser panel was found to provide the desired results in a 3 by 2 m light box employing six 58W lamps.

An example of a pattern of reflective material which may be adopted on a panel 22 is shown in Figure 5. As illustrated, the size and/or spacing of elements of the pattern can be varied to alter the proportion of a given area which is covered by reflective material. In the pattern of Figure 5, a greater density of reflective material is employed in areas which correspond to the projected position of the tube edges, and a lesser density towards the longitudinal edges of the panel. As shown in Figure 6A, the side of the panel 2 facing the advertising poster may be plain or, as in the panel 28 of Figure 6B, have a prismatic configuration which will spread the transmitted light over a wider area of the poster.

Preferably, the back panel of the light box, which is normally coated with wet or powder coated white paint, is replaced by a highly reflective and highly diffusive laminated sheet as shown in Figure 7. The substrate may be formed

of any suitable material such as steel, aluminium, glass fibre, plastic or wood. It is laminated with highly reflective plastic sheet that is also a highly diffusive medium. In the preferred example, 94% of incident light is reflected and diffused. Normally highly reflective films which reflect above 90% of incident light have very low diffusion in the order of 4-10% and would not optimise the light box performance.

To further increase the reflective efficiency of the light box, the sides and the operating control gear and much of the wiring should be obscured by a cover 34 as shown in Figure 8. The interior of the box including the cover 34 may be coated with white paint or, in the preferred version, overlaid by a laminated sheet with the same construction as shown in Figure 7.

A light box according to a second embodiment is shown in Figure 9 which is double sided so that posters can be displayed on both sides thereof. In this configuration, a panel 22 is placed on each side of the lamps 12. Reflectors on the internal periphery of the light box are used to prevent light absorption by wiring and gear trays or controllers, for example. These reflectors may be coated with white paint, or covered by diffusive reflective aluminium or laminated panels with the same construction as those illustrated in Figure 7.

Use of partially reflective panels as described herein in illuminated light boxes provides a number of advantages including more efficient light transmission greatly reducing energy costs, and more effective diffusion of light thereby substantially eliminating "striping". It may also enable light boxes to be constructed with slimmer profiles to improve their appearance and ease of handling.

CLAIMS

1. A partially reflective panel comprising sheet material, areas of which reflect light energy and form a pattern extending in the plane of the sheet, with portions of the sheet material in the remainder of the plane being able to transmit light energy.

2. A panel according to Claim 1, in which an absorbent material is provided behind the light reflective portions.

3. A panel according to Claim 2, in which the absorbent material is provided on the same side of the sheet as the light reflective portions.

4. A panel according to Claim 2, in which the absorbent material is provided on the opposite side of the sheet to the light reflective portions.

5. A panel of any one of the preceding claims, wherein the proportion of the plane of the sheet consisting of transmissive portions in one region of the sheet is different to that in another region.

6. A panel of any one of the preceding claims, wherein the proportion of the plane of the sheet consisting of reflective areas in one region of the sheet is different to that in another region.

7. A panel of Claim 6, wherein the pattern of reflective areas comprises circular dots of varying diameter.

8. A panel of any of Claims 5 to 7, wherein the proportion of the plane of the sheet consisting of transmissive portions in each region of the sheet is selected to correspond to a specific light source such that the intensity of light transmitted by the panel when located adjacent the light source is substantially uniform over the plane of the panel.

9. A panel of any preceding claim wherein both sides of the sheet are substantially planar.

10. A panel of any of Claims 1 to 8, wherein prisms are provided on one side of the sheet to increase diffusion of light transmitted by the sheet.

11. A panel of any preceding claim wherein each reflective area comprises a layer of light reflective material on one side of the sheet material, and the sheet material is substantially transparent to light energy to provide the transmissive portions.

12. A panel of Claim 11, wherein the layer of light reflective material and/or the absorbent material is applied by a screen-printing process.

13. A panel of Claim 11, wherein the pattern of reflective areas is formed by etching a layer of light reflective material.

14. A panel of Claim 11, wherein the pattern of reflective areas and/or the absorbent material is formed by laminating the sheet material with a printed film.

15. A method of producing light energy of substantially uniform intensity over a predetermined area comprising providing a light source, and locating adjacent to the light source a panel of any preceding claim.

16. An internally illuminable container comprising a front wall and side walls, at least one light source, and a panel of any of Claims 1 to 14 mounted between the light source and the front wall such that the intensity of light energy from the light source transmitted by the panel towards the inner surface of the front wall is substantially uniform.

17. A container of Claim 16, including a back wall opposite the front wall, the surface of the back wall being highly reflective and diffusive.

18. A container of Claim 17, wherein around 90% or more of the light energy incident on the back wall is reflected and diffused.

19. A container of Claim 17 or Claim 18, wherein the back wall comprises a sheet of reflective and diffusive material on the inner surface thereof.

20. A container of Claim 16 including a back wall, and a panel of any of Claims 1 to 14 mounted between the at least one light source and each of the front and back walls.

21. A partially reflective panel substantially as shown in or as described with reference to Figures 4 to 9 of the accompanying drawings.

22. A container substantially as shown in or as described with reference to Figures 4 to 9 of the accompanying drawings.

Application No: GB 0029239.1
Claims searched: 1-22
Examiner: Steven Gross
Date of search: 17 May 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): G5C (CEK, CEL), F4R (RCC, RFM, RCK, RCAA)

Int Cl (Ed.7): G09F13/04, 13/08, 13/10, 13/18, F21V13/00, 13/10, 11/14

Other: Online: EPODOC, WPI, PAJ

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2182130 A	(BRON) See especially page 1 lines 41-107	1, 5 - 11, 15
A	EP 0395344 A2	(MITSUBISHI) See especially figures 2 - 4	10
X	US 5134549 A	(YOKOYAMA) See especially column 3 line 54 to column 5 line 56	1, 5 - 9, 11, 12, 15
X	US 5057974 A	(MIZOBE) See especially column 4 line 3 to column 6 line 2	1, 5 - 10, 11, 12, 15
X	US 4267489 A	(OHNO) See especially column 2 line 52 to column 6 line 7	1 - 9, 11, 12, 15 - 20

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